CLAIMS

We claim:

1. A method of co-injection molding, the method comprising:

mixing a plastic inner material and an endothermic-blowing agent to form a core mixture;

injecting a plastic outer material from a first injection unit into a co-injection manifold to create a flow of outer material therethrough;

injecting the core mixture from a second injection unit into the co-injection manifold to create a flow of core mixture therethrough;

controlling the flow of the outer material and the flow of the core mixture through the co-injection manifold and into a mold cavity thereby co-injection molding the core mixture inside the outer material; and

expanding the core mixture by providing heat for the endothermic-blowing agent to absorb.

2. The method of claim 1, whereby providing heat for the endothermic-blowing agent to absorb occurs before the outer material and the core mixture are injected into the manifold.

3. The method of claim 1, whereby providing heat for the endothermic-blowing agent to absorb occurs after the outer material and the core mixture have been injected into the manifold.

4. The method of claim 1, whereby providing heat for the endothermic-blowing agent to absorb occurs while the outer material and the core mixture are being controlled through the manifold.

5. The method of claim 1, wherein the endothermic-blowing agent comprises a mixture of sodium bicarbonate and sodium hydrogen citrate.

6. The method of claim 1, wherein the endothermic-blowing agent includes at least one of aliphatic and halogenated hydrocarbons, low boiling alcohols, ethers, ketones, aromatic hydrocarbons and simple salts.

7. The method of claim 5, wherein the simple salts are selected from the group consisting of ammonium bicarbonate, sodium bicarbonate and azobisformamide.

8. The method of claim 1, whereby controlling the flow of the outer material and the flow of the core mixture comprises allowing the core mixture to enter the mold cavity only after the outer material enters the mold cavity, and then allowing the core mixture and the outer material to flow into the mold cavity concurrently.

9. The method of claim 8, whereby controlling the flow of the outer material and the flow of the core mixture further comprises stopping the flow of the core mixture into the mold cavity and the flow of the outer material into the mold cavity substantially simultaneously.

10. The method of claim 8, whereby controlling the flow of the outer material and the flow of the core mixture further comprises stopping the flow of the core mixture into the mold cavity before stopping the flow of the outer material into the mold cavity.

11. The method of claim 8, whereby controlling the flow of the outer material and the flow of the core mixture further comprises stopping the flow of the outer material after the outer material concurrently flows with the core mixture, thereby allowing the core mixture to remain flowing.

12. The method of claim 11, whereby controlling the flow of the outer material and the flow of the core mixture further comprises stopping the flow of the core mixture into the mold cavity, and resuming the flow of the outer material into the mold cavity.

13. The method of claim 1, whereby controlling the flow of the outer material and the flow of the core mixture comprises allowing the outer material to enter the mold cavity before the core mixture, stopping the flow of the outer material, allowing the core mixture to enter the mold cavity thereafter, stopping the flow of the core mixture into the mold cavity, and resuming the flow of the core mixture into the mold cavity.

14. A co-injected plastic article manufactured by a co-injection process comprising:

melting an inner material and an endothermic-blowing agent to form a core mixture;

injecting a plastic outer material from a first injection unit through a co-injection manifold and into a mold cavity;

injecting the core mixture from a second injection unit through the co-injection manifold and into the mold cavity;

co-injection molding at least a portion of the core mixture inside the outer material in the mold cavity;

expanding the core mixture by providing heat for the endothermic-blowing agent therein to absorb; and

allowing the outer material and core mixture to cool in the mold cavity, thereby forming a co-injected plastic article, wherein about 20.0 to 45.0 percent by volume of the article is inner material and about 0.1 to 4.0 percent by volume of the inner material is endothermic-blowing agent.

15. The article of claim 14, wherein the co-injected plastic article is a steering wheel.

16. The article of claim 14, wherein the co-injected plastic article is a hood for a vehicle.

17. The article of claim 14, wherein the co-injected plastic article is a toilet seat.

18. The article of claim 14, wherein the co-injected plastic article is lawn furniture.

19. The article of claim 14, whereby the method by which the article is made further comprises allowing the core mixture to enter the mold cavity only after the outer material enters the mold cavity, and thereafter allowing the core mixture and the outer material to flow concurrently into the mold cavity.

20. The article of claim 14, whereby the method by which the article is made further comprises allowing the core mixture to enter the mold cavity before allowing the core mixture to enter the mold cavity, stopping the outer material from entering the mold cavity, allowing the core mixture to enter the mold cavity thereafter, stopping the flow of the core mixture thereafter, and resuming the flow of the core mixture into the mold cavity.

21. A method for manufacturing an engineering-grade resin, the method comprising:

adding an endothermic-blowing agent to an inner material;

exposing the blowing agent and inner material to a temperature between about 300-600° F and a pressure between about 5,000-25,000 PSI to form a core mixture;

injecting an outer thermoplastic material from a first injection unit through a co-injection manifold and into a mold cavity;

injecting the core mixture from a second injection unit through the co-injection manifold and into the mold cavity to create the resin, the outer material insulating the core mixture in the resin, and the resin being capable of forming a plastic article upon being cooled.

22. The method of claim 21, wherein 20-45 percent by volume of the resin is inner material and about 0.1-4.0 percent by volume of the inner material is endothermic-blowing agent.

23. The method of claim 22, wherein the blowing agent is about 0.5 to 3.0 percent by volume of the inner material.

24. The method of claim 23, wherein the blowing agent is about 1.0-2.0 percent by volume of the inner material.

25. The method of claim 21, wherein the plastic article is at least one of a handle, a wheel chair handle, a toilet seat, a vehicle hood and lawn furniture.

26. The method of claim 21, wherein the endothermic-blowing agent is a mixture of sodium bicarbonate and sodium hydrogen citrate.

27. The method of claim 21, wherein the endothermic-blowing agent is selected from the group consisting of aliphatic and halogenated hydrocarbons, low-boiling alcohols, ethers, ketones, aromatic hydrocarbons and simple salts.